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CANTOR LECTURES.

"On some of the most important Chemical Discoveries made within the last Two Years." By Dr. F. Crace Calvert, F.R.S., F.C.S.

Lecture I.

Delivered on Tuesday, the 4th of April, 1865.

On the Discoveries in Chemistry applied to Arts and Manufactures.

In this lecture I intend to treat of chemistry applied to the arts, and more especially to some of the discoveries which have been made within the last two years. Many of these will appear to you to be incomplete, but if complete they would not be new, for seldom are discoveries perfected at once. They are generally the result of many years' study, and of the thoughtful consideration of several men.

The first part of this lecture will have reference to some of the applications which the laws of light have received during the last few years; and it will, I hope, convince you of the necessity of every one engaged in the arts making himself acquainted with all the laws connected with the phenomena of light, to enable him to appreciate the discoveries which have been made, or to assist him in improving upon those which are already known, as they are constantly receiving the most valuable applications in the arts and manufactures. Thus, for example, M. Donné has applied the properties of light to ascertain the relative values of milks by the amount of cream they contain, and this he effects by an instrument which he calls the lactoscope. Dubosch Soleil has applied with great success one of the most complicated laws of light—viz., polarised light—to the commercial estimation of the various qualities of sugars. By this process the sugar refiner, or any other person interested in that product, is enabled to ascertain in half-an-hour exactly the amount of crystallised sugar there is in a given sample, as compared with the quantity of non-crystallizable, or what is commonly called treacle. M. Dubosch Soleil's apparatus is considered so accurate that the French Government has adopted it to determine the value of raw sugars imported into the country, and the customs duties are levied upon the results given by this instrument. I may further add that this apparatus, called "Polarising Saccharometer," is based on the peculiar property which light has when polarised, or when its rays are received at an angle of 35°25′ degrees on a plate of tourmaline or a mirror. M. Dubosch Soleil's apparatus enables him to work with polarised light, which presents the various colours of the spectrum, in such a way as to enable him thereby to determine, as I have already stated, the amount of crystallizable sugar in any given quantity of the article, sufficiently accurately for all commercial purposes.

It is impossible for me, in a single lecture, to attempt to give you an idea of the various improvements which have been effected, even within the last two years, in the arts of photography, Talbotype, photozincography, glyphography, or other processes which are due to the action of light on sensitive surfaces; but you will find an excellent paper on the application of photography, and also of light to sensitive surfaces as applied to the art of engraving, in vol. xiii., page 131, of this *Journal*, by Mr. S. T. Davenport, under the heading of "Engraving and other Reproductive Art Processes." Still there are two discoveries which appear to me to deserve passing notice, viz., the carbon process of Mr. Swan, and also the process discovered by M. Villème, and now carried on in London by a company, by which the operator is enabled not only to take the photograph of a person, but to produce a statuette giving a full representation of the figure itself, and a far more accurate personification than could be produced by any sculptor, and that at a cost of as many shillings as the sculptor would expect pounds. But the most important series of researches which have been made of late years in connection with photography, and to which I deem it my duty to call especial attention, are such as to acquire more and more importance as they are more developed; I therefore feel convinced that any one who will devote his talents to the study of this particular branch of photography, will in time be amply rewarded, and of this there can be no doubt, when we consider the results already obtained by the labours of only two or three gentlemen. I refer to the reproduction of the various colours of the spectrum upon sensitive surfaces. In 1838, Herschel was the first to publish a paper on the various colours which chloride of silver is susceptible of taking under the influence of certain coloured rays of light. Mr. Robert Hunt also published, in 1840, a paper referring to the subject; but the most complete series of researches on the subject of the reproduction of the colours of the spectrum, and which led to a process by which several of the colours of the spectrum could be reproduced on a sensitive surface, is due to Edmund Becquerel. The results arrived at by this gentleman were so remarkable that they drew the attention of the whole scientific world; and the following is an outline of the processes which were applied by him to obtain this interesting result. He took a daguerreotype plate or a silver plated one, and having dipped it in a weak solution of chlorine, or, what was still better, a weak solution of hydrochloric acid, by connecting it with the poles of a battery, the brilliant silver surface acquired different tints, passing gradually from an opaque white to a black tint. He also observed that the tint best suited to obtain favourable results was when the plate had acquired a pearlish pink; and although he found that the plate so prepared, when placed in the camera obscura, assumed the colours composing the spectrum, still they were faint, but he remedied this defect of intensity of tints by heating for several hours to a temperature of 95° to 100° the chlorinated plate, and then submitting it to the influence of the various colours composing the spectrum. Further, in the course of his studies he made the important observation that he could replace the peculiar action of heat on his prepared daguerreotype plate by exposing it to the rays of the sun under a sheet of paper which had been steeped in an acid solution of sulphate of quinine. The effect of this was that the plate of silver assumed an intense white colour, nearly resembling that of paper; whilst, if the protective paper had not been used, the silver plate would have gradually acquired a dark tint, and would have lost the whole of its sensitive properties, the protective paper having the power of arresting completely the most refrangible rays of light, especially those which are beyond the line H of the spectrum. Notwithstanding M. Edmond Becquerel's ardent hopes to find a method which would enable him to fix on a sensitive surface the various colours of the spectrum, still he failed, for they faded immediately they were exposed to the direct rays of light, and could only be preserved in obscurity. But there is one gentleman who deserves great praise for the extraordinary perseverance which he has shown in this class of investigation. I mean the nephew of the discoverer of photography, M. Niépce de Saint Victor. Although I will not enter here into the details of these valuable researches, as they can be found in the *Comptes Rendus de l'Académie des Sciences*, still I may just be allowed to state that he has not only by the following process obtained far more brilliant colours than those first produced by M. Becquerel, but has succeeded in reproducing on sensitive plates the various colours of coloured surfaces, such as are presented by fabrics, flowers, &c., and further, he has lately been so fortunate as to reproduce on his plates yellow and black tints, which had resisted all previous attempts. To give you an idea of the facts arrived at by this gentleman, I may state that he has succeeded in so fixing upon sensitive surfaces, the various colours of the spectrum, or of coloured surfaces, that they will bear the action of diffused light for several days. In fact, I have seen photographs which reproduce faithfully a small doll dressed up in various colours, and in which even the most minute ornament could be traced, and what is certainly not less interesting was the reproduction of the irridescent colours of the peacock's feather. To obtain these marvellous results, M. Niépce de Saint Victor takes a daguerreotype, or silver-coated plate, and dips it into a weak solution of hypochlorite of sodium, having a specific gravity of 1.35, until it has assumed a bright pinkish hue. The plate is then covered with a solution of dextrine, saturated with chloride of lead; it is then dried, and subsequently submitted to the action of heat, as in M. Becquerel's experiment, or under the screen of sulphate of quinine, also referred to above. The plate is then ready to be placed in the camera obscura, and to receive the colours of the spectrum, or representations of nature, such as flowers, as well as certain colours produced by man. Lastly, he succeeds in increasing the stability of the colours developed on the sensitive surface, by covering the plate with an alcoholic solution of gum benzoin, and M. Niépce gives the name of Helio-chromie to this branch of photography.

During his lengthened researches, M. Niépce de St. Victor has made two series of observations which I deem it my duty to lay before you, viz., that he can produce with facility, on prepared plates, the binary colours of the spectrum, viz., orange, violet, indigo, and green, if those colours are natural; but if they are artificially produced by the mixing of two of the primary colours, as red and yellow, or orange and blue, and yellow or blue, he cannot reproduce the binary colour, but only one of the two colours employed by the artisan to prepare them. Thus, for example, he can reproduce the natural green of malachite, and the beautiful colour known as Scheele's green, but he cannot do so with a mixture of Prussian-blue and yellow chromate of lead, the blue only reappearing. These facts enable him to explain why, in ordinary photography, the leaves of plants always appear black, and why, when he attempts to fix on his plates the colours of leaves, they have a bluish hue, the yellow portion of the colour not being reproducible.

M. Niépce has made another series of observations which deserve notice, viz., that when a plate, as prepared by his process, is dipped in an alcholic solution of substances susceptible of imparting a colour to flame, such, for example, as strontia, which communicates a red hue to it, or baryta, which gives a yellowish-green colour, the prepared plates when exposed in the camera will assume the same colour as the salt which they have on their surface would impart to the flame of alcohol; and if a salt of copper be used, which has the property of communicating a variety of tints to the flame of alcohol, the plate also will assume a variety of tints when exposed to the action of light; and during a certain period of his lengthy researches M. Niépce availed himself of this curious phenomenon to obtain coloured plates in the camera. They are not only interesting as reproductions of art, and as a feat of extraordinary skill in the progress of photography, but they are especially so because in time they will lead to methods which will enable us to communicate to our little children perfect and correct views of our time, and other interesting facts connected with the period in which we live.

All persons interested in the progress of photography will find full details of the new processes for reproducing vitrified photographic plates in vol. 60, page 1239, of the *Comptes Rendus de l'Académie des Sciences*, 1865; these I omit, as they are purely technical, and have only an interest for those immediately engaged in that branch of the photographic art.

I shall now have the pleasure of calling your attention to a most important series of researches published by Professors Bunsen and Roscoe; but, to enable you to appreciate their value, it is necessary that I should make the following remarks:—It is now well known that the solar spectrum is composed of three primary colours—blue, yellow, and red; and, also, of four complementary or binary colours, viz.—orange, green, indigo, and violet. It is also known that those colours represent different properties or qualities of that universal fluid called ether, which, I may say was generalised by Sir Isaac Newton under the name of gravitation, on which the whole of the planetary system is based, and which gives to the universe its harmony and stability. This fluid is susceptible, under certain influences, as those generated by the sun, of being set in vibration, and thus are generated heat, light, and chemical rays; and further, as there is no chemical action without a corresponding production of electricity, it follows that electricity, as well as magnetism, may be considered as a mere modification in the vibrations of the same fluid. Therefore we may truly say that all the imponderable fluids called Light, Electricity, Heat, Magnetism, and Force, have all the same origin, namely, the fluid called ether, and which, according to the nature of the vibrations, developes or renders palpable to our senses one of those fluids. In fact, I feel convinced that this unique fluid is not converted into those divers fluids by special modifications of its own vibrations, but that they only become manifest to our senses when it has imparted its own or special vibration to the particles of matter, and that it is the peculiar vibration which it imparts to the molecules of matter that developes in the molecules themselves such a mode of vibration as gives birth to what we call light, electricity, magnetism, heat, and force. In fact, there is no doubt, from the researches of Dr. J. P. Joule, Professors William Thomson, Mayers, and others, that heat and force are the same fluid, for Dr. Joule has given us the exact measurement of that force. He has demonstrated that the amount of heat necessary to raise one pound of water one degree in temperature, would, if applied mechanically be competent to raise one pound weight 772 feet high, or it would raise 772 pounds one foot high. The term "foot pound" has been introduced to express in a convenient or systematic way the lifting of 772lbs. to the height of one foot. Thus the quantity of heat necessary to raise the temperature of a pound of water one degree being taken as a standard, 772 foot pounds statute, is what is called the mechanical equivalent of heat. Dr. Tyndall, in his valuable work on "Heat considered as a Mode of Motion," gives many interesting examples of the conversion of heat into force, and *vice-versa*. For example, he cites the following theory of Professor Thomson, who assumes that an immense amount of force is converted into heat when meteoric matter is attracted to the surface of the sun by the molecular attraction called gravitation; that the force generated by the immense velocity with which meteoric matters travel towards the sun, becomes converted instantly by its contact with the sun into heat; and further, he considers, that the showering of meteoric matter, as well as that of the zodiacal lights on the sun's surface, are sufficient to acount for the immense heat which he supposes the sun's surface to possess. I must say that I do not believe that the sun possesses much heat or light; I believe that it is only an immense mass which, by its size as compared with the rest of the planetary system becomes the centre of gravitation; and that there exists between it and the planetary bodies a constant state of attraction; that the fluid called ether, which represents the force called gravitation, is in a constant state of activity throughout the universe, and brings about that Godly and admirable harmony which pervades it; and although the ether filling space can be considered in a constant state of action or vibration, and convertible into the fluids which we call heat, light, electricity, and magnetism, still these fluids only become manifest to our senses when they put into vibration the particles of matter, or produce, according to their peculiar vibration, the phenomena of light, electricity, magnetism, heat, and force; for if heat is convertible into force, as asserted by the researches of the eminent *savants* above stated, why should not the production of other fluids be due also to similar phenomena? If it be true, as Joule, Thomson, and others contend, that force and heat are due to the vibration of the molecules of matter, and that according to the rapidity of the vibrations of such atoms (imparted to them by the vibrations of ether) one or other of these forces is engendered, why should not the manifestations of other fluids be traced to similar causes? In fact, no doubt can exist in my opinion with respect to electricity and magnetism, for if their manifestations to our senses were owing to the vibration of a universal force it would affect all bodies in the same way and in the same degree. Now this is not the case; for there are good and bad conductors. Therefore it follows that the atoms composing matter, or more so, their nature, have an influence on its degree of manifestation. The same with magnetism; for we find oxygen to be magnetic, and nitrogen non-magnetic or diamagnetic. Thus it appears to me from these facts, which might be multiplied if time permitted, that the manifestations of heat, force, electricity, and magnetism are not peculiar and distinctive fluids, but are due to the modification in the mode of vibration of the universal fluid called ether, which imparts to matter its peculiar undulations, and that these forces are only made manifest to us when the vibrations come into contact with solid matters such as compose the atmosphere or the earth. Therefore, I am of opinion that there is no light, heat, electricity, or magnetism beyond the limits of the atmosphere which surround the earth: but that when the ether, which is in a state of vibration, comes in contact with the particles of matter composing our atmosphere it then communicates one of its own peculiar vibrations to these particles; then they, by their vibrations, become luminous. If this theory is correct, it follows that the production of the phenomena of light is due to the vibrations of solid matter, and not to the vibrations of the ether, as is assumed by the philosophers of the day.

I very well know that these views of mine are completely in contradiction with those entertained by most of the philosophers of the day; but still I hope to be able to publish a sufficient number of scientific researches, as well as to draw attention to such a number of physical, chemical, and astronomical facts as may, even if not proving the truth of my views, at all events, I hope, deserve some attention.

Now, let us return to the subject under consideration, viz., that a spectrum is produced by the decomposition of light when it is refracted at an angle of 60°; and that the result of that decomposition is the production of three primary and four binary or complementary colours. Further, that the red portion of the spectrum represents calorific rays of light; that the green and yellow represent light-giving rays, and violet and the rays beyond it the chemical or actinic rays of the same. Philosophers have for a long period been able to measure accurately the intensity of the heat-giving rays, by means of a thermometer or the thermo-electric pile; and though we had a general knowledge of the intensity of the chemical rays of light, still we had no method of accurately measuring its real intensity, and conveying our results and observations to others, till Professors Bunsen and Roscoe filled up this important gap. These gentlemen's researches will be of great service to science and to society, as they will throw much light on many meteorological data, and enable a chemist to study with more precision than has been previously done the chemical phenomena of vegetation and other phenomena connected with the chemistry of agriculture. For example, the thermometric observations giving the mean monthly or yearly temperature of a country, by no means yield all the data required for the estimation of the true climatology of the place, or of its plant or animal producing capabilities. For these purposes we require to have not only the amount of solar heat directly or indirectly reaching the spot, but likewise the amount of chemical active solar light which may be present there. This is strikingly exemplified by the following example given by Dr. Roscoe on a comparison of the mean annual temperature between Thorshawn, north latitude, 62° 2′; west longitude, 6° 46″; temperature, 45° 6′; and Carlisle, north latitude, 54° 55′; west longitude, 2° 58″; temperature, 46·9°; difference, 1·3. From these figures it will be seen that the mean annual temperature is nearly equal, but the quantity of sunlight falling upon those two places differs most widely, and we have a corresponding difference in true climatological results. Thus the flora of the Faroe Islands and the Shetland Islands is of a most limited description. Only hardy varieties of shrubs, and no trees or flowers exist there, while at Carlisle we have a luxuriant vegetation accompanying a most sunny sky. How essential, then, are the rays of light to vegetation. These gentlemen have also ascertained that those rays are in ratio with the intensity of that light; and still further they are also in ratio with the chemical or actinic rays of the sun; and thus the researches of these savants will enable them to measure with accuracy those chemical actions. It is impossible, in a lecture like this, to render justice to their researches, therefore I must refer those who wish to consult them to the Philosophical Transactions of the Royal Society. Still I may state that these gentlemen's photochemical instruments are based on the following data, namely, that equal intensity of light produces in the same given space of time equal shades of tint on surfaces prepared with chloride of silver of uniform sensitiveness. Thus it is shown by experiments that a tint attained by paper so prepared is constant when the quantity of light falling upon it also remains constant. Light of an intensity of 50° falling upon a paper for the time of one minute produces the same blackening effect as light of the intensity of one falling upon it for the time of 50 minutes. Knowing these laws which regulate the degree of shade of the paper, and having a surface of a perfectly constant degree of sensitiveness, it is easy to obtain the absolute measurement of the chemical action of light.

The next discovery to which I desire to draw your attention is still in its infancy; but I am induced to refer to it from two considerations. The first, that it may render great service to society by enabling us to preserve the lives of many thousands of our fellow-creatures in our coal-mines and other underground works, and also because it is a beautiful illustration of the amount of knowledge that a man requires at the present day either to understand or appreciate fully the discoveries of others, or to enable him to attempt any original invention of his own. Unless a person possesses the rudiments of the leading sciences of the day he will never be anything but an imitator, and will never succeed in improving the inventions already made. It is certainly most interesting to witness how the most abstruse branches of science are brought to bear on arts and manufactures, and no better example can be given than the application of electricity under various forms to what is commonly called the telegraph. The invention which I am now about to bring to your notice is due to M. Dumas, a young French engineer, and to M. Brequet, of Paris, who is also practically connected with telegraphy. To enable these gentlemen to carry out their discovery they have had to study, and be perfectly acquainted with, the researches of many of the most eminent men that science has produced during the last half century. Thus they employ the galvanic battery which was discovered by Galvani, and perfected by many philosophers, until brought at last to its present perfection. They use a mixture of bichromate of potash and sulphuric acid in a Bunsen battery. They have also had recourse to magneto-electricity, first discovered by Faraday, and brought to its present perfection by the researches of MM. Nobili, Mason, Becquerel, Joule, and others; and to enable them to construct their apparatus they have applied, with great ingenuity, the inductive coil, the result of many successive discoveries, and brought to great perfection by Ruhmkorff, the vibrating interrupter of Dancer, and also the condenser of Fiquier. Further, they must have had the knowledge of the stratified light and the application of it by Gassiot; the fluorescence of light by Stokes and Becquerel, and their applications to glass by Geissler. All these facts prove the correctness of my statement, how vast is the amount of knowledge required to make a little discovery. The apparatus invented by these gentlemen is portable, for a miner carries on his back the above-mentioned galvanic battery, and this generates the force required, which is multiplied, increased, and brought to light by the Ruhmkorff coil, which is also confined in the same leather case, occupying only six inches; the magneto-electricity passes through wires covered by vulcanised india-rubber, and these are in connection with a thick glass tube, in which a vacuum has been made, and this contains a fluorescent tube of Geissler, which becomes luminous or fluorescent by the passage of the electricity through it, generated by the coil and the battery.

Although both light and electricity are most interesting subjects, and could well be made the subject of many lectures, still I am bound to leave them on one side, and draw your attention to other facts deserving of notice. It is well known to all chemists and philosophers that matter has a great tendency to assume a geometrical or crystalline form, and that whenever the atoms of matter are sufficiently free for molecular attraction to have its full influences attraction between the atoms takes place, and gives birth to well-defined crystals. The following examples can be cited:—The slow condensation of the vapour of iodine, which gives rise to well-defined crystals, as well as those of camphor and other volatile bodies. When sulphur, bismuth, and other substances are melted, and allowed to cool slowly, and the excess of the fluid remaining among the crystals is poured off, well-defined crystals are found to exist in the mass, which apparently would have disappeared had not the excess of fluids been poured off, for in this case the molecules of the remaining fluid mass would have solidified among the crystals, and would have prevented the observer from seeing that the molecules when freed in the fused mass had assumed a crystalline form. The tendency of molecules to assume a geometrical form presents in many instances curious phenomena. Thus, for example, a vessel may contain acetic and carbolic acids—and if, say at a temperature of 40° or 50°, a crystal of either of those substances is placed in contact with its own fluid, the entire bulk of fluid passes in a few seconds into a solid crystalline mass. The manifestation of that force is also beautifully illustrated in the following instance:—If a tin plate be heated to a moderate temperature, and a drop of water be allowed to fall on its surface, and the plate be dipped for a few minutes into weak muriatic acid, it will be observed that the whole surface of the plate is affected, and that where the water fell it has assumed a most beautifully waved and irridescent surface. If this surface be examined under the microscope it will be found that under the influence of the vibrations generated by the cold fluid falling upon the heated plate, the mass of molecules have passed from their amorphous condition to that of a crystallised one. We all know this alteration in the tin-plate surface was particularly applied many years ago to produce variegated surfaces on our tea-trays and other similar domestic vessels. It should also be stated that this effect was greatly enhanced by the skilful application of coloured varnishes, which increased the value of the mercantile article. This discovery, which is due to an eminent chemist of the name of Prout, clearly proves, as those before cited, the power which matter has to assume a crystalline form. I cannot, however, refrain from adding the following instances, in which the mere vibration of particles of matter is sufficient to change amorphous bodies into crystalline ones. The first is that which often takes place in the iron used on railways. The most striking example is that of the iron links used to unite waggons where it is found that the fibrous, tenacious link made of malleable iron is transformed into a crystallised, brittle link by the constant vibration it is subjected to by railway traffic. Another example is that shown by the peculiar action exercised by intense cold on the molecular state of iron, as shown by the brittleness of the metal in Russia and other cold climates; this was the case in December, 1859, in England, when, as will be remembered with regret, many railway accidents occurred, owing to the rails becoming crystallised and brittle.

The power which molecules have to assume a crystalline form has recently been the study of Mr. F. Kulhmann, an eminent chemist of Lisle, and he has given to that force the name "crystallogenic." I shall endeavour to lay before you a short epitome of his researches, which are not only interesting in a scientific point of view, but also in consequence of the mode in which he has applied it in connection with arts and manufactures; and those who take an especial interest in the matter will read with pleasure his researches in the *Comptes Rendus de l'Académie des Sciences de Paris.* M. Kulhmann, having mixed a certain class of substances which crystallised with facility, (such as mannite, sulphate of zinc iron, copper, with a thick solution of gum, or any other substances interfering with the free crystallisation of these substances and having spread the mixtures on glass, he found, by exposing such prepared plates to the atmosphere, that gradually the water would evaporate, leaving a dry mass, in which could be observed most beautiful arborizations. Each of the solutions will produce a well-defined design which is not always identical although operating under the same circumstances. Still they assume very similar forms, being in some instances that of stars, and in others that of leaves and wreaths. These modifications are obtained by the strength of the solution, the nature of the salt and the mode of preparation. Kulhmann further observed, that if amorphous substances, such as magnesia and sesqui-oxide of iron, or chromium, be mixed with bodies susceptible of crystallisation, and these added to a gummy fluid, the amorphous particles are drawn into the crystallising substances and follow the outlines; and if these are produced on surfaces, such as those of glass or porcelain, and heat applied, the gummy matter will be destroyed or volatilised, and the crystalline medium and the amorphous substances become incorporated, and fixed in the porcelain, reproducing on its surface a crystallogenic design. These researches which I have the pleasure to lay before you will show you the probability of carrying out these results to a satisfactory issue. Of course, the glass or porcelain manufacturer will easily understand that he will have to use borax or phosphate of soda, or other flux, as a crystallising medium, if he wants to produce in his art the results that I have stated. M. Kulhmann has applied his crystallogenic process with great success to photography, and also to the art of engraving metals. As the latter may have some interest, I will give you an outline of his process. It consists in producing a crystalogenic design on the surface of an iron or copper plate, and then applying on the so-prepared surface—say a sheet of lead or copper—and submitting them to high pressure when the design would be impressed upon the plate. The embossed plates, by being placed in a prepared solution, and in connection with a galvanic current, will easily give birth to a *fac-simile* in relief, which can be used as a printing surface. It is with pleasure that I am able to state that though I part with these interesting researches for the present, I shall have the satisfaction of referring to them again in a subsequent part of this course of lectures, when I shall speak of some researches of this gentleman which have a more immediate bearing on the progress of science.

It has been for a long time a disputed question whether the stained windows we all admire in old cathedrals could be restored in such a way as to resume the brilliancy they had at the time they were placed there by the artists. At all events there is now no doubt that this can be effected by the process discovered by my eminent master, M. E. Chevreul, as is proved by the application of it in connection with the restoration of stained windows existing in a well-known church in Paris—that from which the tocsin of St. Bartholomew was sounded, "St. Germain des Près." The process devised by M. Chevreul is highly practical; it consists in removing the stained glass from the windows, and dipping it for several days, first, in a weak solution of carbonate of soda of a specific gravity of 1·068, then washing it, and dipping it for several hours in a solution of muriatic acid of a specific gravity of 1·080. On the glass being washed and dried, it will be found as brilliant and beautiful as when it came from the hand of the manufacturer. M. Chevreul has found that the dim and dirty appearance which stained glass assumes by time is due, especially in large towns, to the various products of smoke being first condensed on the glass by fog and rain, and then becoming oxydised they act as a cement to various mineral matters, such as chalk, gypsum, oxyde of iron, &c., which help to impoverish the transparency of the glass. The alkali acts upon the organic matter and dissolves it, while the muriatic acid removes the minerals. The durability of glass placed in our monuments is extraordinary, when we bear in mind the curious results published some years since by the eminent chemist, Pelouze, who observed that when window, bottle, and other varieties of glass were reduced to a fine powder, and mixed with water, they were soon acted on, yielding a large quantity of silicate of soda to that fluid, amounting in several cases to eight or ten per cent. in cold water, and even to thirty-six per cent. when the finely pulverised glass was boiled in water; and that, in many cases, it was a definite compound which was dissolved from the glass, namely, a silicate of soda, composed of three equivalents of silica and two equivalents of soda. M. Pelouze explains the extraordinary difference in the effect which water produces on glass when in large masses or plates, as compared with its influence on the same substance when reduced into a fine state of powder, by assuming that, in the first instance, water does not act because it seldom remains sufficiently long in contact with the glass to act upon the elements which compose it; while, in the second case, there exist numerous points of contact between the fluid and the solid body, thus facilitating the action of the fluid on the solid material. I am inclined to think that the peculiar molecular condition the surface of glass assumes, when manufactured in plates or otherwise, must exercise a great influence on the property which glass has to resist the action of water. If it were not so, how could be explained the limited action which watery fluids, such as wine, cause upon the interior surface of a bottle, though they remain in contact for many years? I can conceive glass assuming a peculiar surface by the pressure of the atmosphere, thereby producing a homogeneous one susceptible of resisting the action of water. A similar instance occurs in the case of polished steel, or of the rolled surface of wrought iron, or the skin of cast iron, which resist the chemical action of either air or acids in a far greater degree than does the interior of the substances which compose those metallic bodies.

Whilst dwelling upon old materials, you will allow me to give you an outline of a process devised by M. Stahl for the preservation of antediluvian fossils. We are aware how interesting it is to preserve relics of past ages, giving us some of the conditions of the world at various periods. Those relics are exceedingly fragile, and after many clumsy attempts M. Stahl arrived at his discovery. If the fossil is compact and comparatively firm, it is saturated by means of a brush with melted spermaceti, but if it is friable, it is necessary to employ a melted mass composed of four parts of spermaceti and one of colophany resin, which in cooling gives great solidity to the mass of the fossil.

I would, in conclusion, draw the special attention to all artists who take an interest in decorative art to the interesting papers published recently by M. Oufroy on the one hand, and M. Wiel, of Paris, on the other; the first being in the *Technologiste* of last year, the latter in the *Annales de Chimie et de Physique*, on their respective methods for covering a metal with another more valuable by its properties or precious by its qualities. These methods have a special reference to cast iron or wrought iron. In Paris these processes, which may be regarded as not only ornamental but useful, have been applied with great success. Thus, for example, instead of the dirty, pitchy black lamposts which ornament our English towns, there can be seen in Paris elegant, well-designed, bronze-like posts, which are pleasing to the eye. The same can be said of the fountains on the Boulevard *Sebastopol*, the Place de la Concorde, and many other public promenades in Paris, which excite the admiration of foreigners visiting that city.

PORTUGUESE INTERNATIONAL EXHIBITION.

The Portuguese International Exhibition was opened on the 18th of September, with great rejoicings. At one o'clock in the afternoon the King and Queen, Dom Ferdinand, and Dom Augusto, entered the Crystal Palace with a brilliant suite, and were conducted through the central nave to the throne prepared for their Majesties; an address was then delivered by Senhor Antonio Braga, President of the Central Committee of the undertaking, to which the King replied in the following terms:—

"Among you, illustrious Portuguese, none may doubt of our progress, none may fear that it is slow and indefinite.

"Nations fall from their splendour by the errors of men or natural calamities. But it is also certain that they rise gloriously to the resonant voice of patriotism and liberty. And with the same rapidity with which they were cast down are they impelled towards prosperity, if with good faith and firm steps they enter upon the path of reforms, the sole course by which the moral and physical regeneration of peoples can be effected.

"This movement, once commenced, becomes a necessity of such magnitude and urgency, that no benefit remains circumscribed by the area traced out by its author.

"Thus Portugal, after a long period of misfortune, which caused her to lose the *prestige* of her past greatness, has now, Providence be thanked, entered upon a new epoch of efforts and enterprises, which, encouraged and fortified by peace and liberty, will assure to her, in a brief future, the place which she once occupied among the most cultivated and fortunate nations.

"The first International Exhibition which took place in the capital of the commercial world was followed by that of Paris. And such is the power and influence of the progress of humanity, that in little more than ten years a city of the second order, in a country hitherto considered to be a century behind most nations, gathers to her bay, for your honour, the manufactures of both worlds and the wonders of art and intelligence.

"This spectacle is, then, a great glory for Portugal, and a well-founded hope for the future. Arduous was the mission of my honoured grandfather in implanting the liberal institutions we now enjoy; and arduous also the task of my august brother, evangelising and exalting among us the sublime idea of the supremacy and glorification of labour.

"Such facts cannot be forgotten, and your allusion to them at once affects and gratifies me.

"Invited by you to assume the presidency of the Crystal Palace, and later to give an impetus, as you express it, to the development of the Exhibition, I acceded with the greatest pleasure, recognising all the importance of the undertaking.

"The spirit of the age, the example of my brother, and the love I bear to my country and my subjects, will lead me to embrace and second with all my endeavours this generous and highly civilising idea, whose realisation will give to our country much higher consideration among foreign nations, and will increase our own self-respect, thus raising public spirit to the height from which naturally and spontaneously spring patriotic actions.

"This contest of labour, this truly national festival, is so striking a proof that we are advancing on the path of progress, it opens up to the national industry so many improvements, and promises such various advantages to the country, that I feel real pride that this great event should take place as a happy presage at the commencement of my reign.

"My honoured father, the enlightened president of the Exhibition, accepted and undertook in the same manner so pleasing a charge. His august name, as you well presumed, immediately secured the public sympathy for this great work. The most distinguished artists, and the most intelligent and industrious nations, hastened to respond to our invitation. No nation, however powerful and advanced, disdained to come and take their place among the laborious Portuguese. Honour to them for this, as it is to us a motive of gratitude.

"To the wishes you express for my happiness, that of my beloved consort, the Prince my august father, the Infante Dom Augusto, and the Royal Family, I respond with the most fervent wishes for the greatness and welfare of the country which has been our cradle."

His Majesty concluded by declaring the exhibition open, amidst the greatest enthusiasm from the numerous and select concourse of spectators, native and foreign. Royal salutes were fired from the forts of Serra do Pilar and Foz in honour of the event. The royal party were afterwards conducted over the various departments of the building, several pieces, specially composed for the occasion, being meanwhile performed on the great organ. The greater part of the foreign diplomatic corps, the whole of the consular body, all the ministers, the court dignitaries, and nearly all the members of parliament, were present at the ceremony, which was favoured by splendid weather. England is very well represented, the display of her manufactures being excellent.

PARIS UNIVERSAL EXHIBITION OF 1867.

The Imperial Commission has issued the following regulations specially referring to British exhibitors:

Section I.—General Arrangements and System of Classification.

Art. 1.—The Universal Exhibition to be held at Paris in 1867 will be open for the reception of works of art and of the products of agriculture and industry of all nations. It will be held in a temporary building on the Champ de Mars. Around the Exhibition building a park will be formed for the reception of cattle and other live animals, and plants, as well as for those constructions and objects which cannot be exhibited in the main buildings. The Exhibition will open on the 1st of April, 1867, and will close on the 31st of October following.

Art. 5.—The commissions appointed by the various foreign Governments to direct the part which their respective countrymen will take in the Universal Exhibition are in direct communication with the Imperial Commission relative to the exhibition of the works of art and other productions of their country. Consequently, the Imperial Commission will not correspond with foreign exhibitors. Products sent by a foreign exhibitor can only be admitted through the medium of the foreign commission which represents him. The foreign commission will also provide, as they may see fit, for the carriage, the reception, the arrangement, and the return of the productions of their countrymen. They must, however, conform to the regulations laid down by the Imperial Commission.

Art. 6.—Foreign commissioners are requested to place themselves as soon as possible in relation with the Imperial Commission, and to depute some person to represent them. The duty of this representative will be to arrange the questions which refer to foreign exhibitors, and particularly those relative to the allotment of the whole space among the various countries, and to the manner in which each foreign section shall be arranged in the Exhibition building and in the park.

Art. 7.—In order to facilitate the division of the space allotted to each country between the various classes of objects enumerated in Article 11, the Imperial Commission will place at the disposal of the representatives for their guidance the plan of the arrangement of the French section of the Exhibition building, drawn on a scale of two millimetres to a metre (1in. to 41·6ft. or 1-500th). This plan shows the arrangement of the glass cases and counters suitable for each class of objects, as well as the shape, height, and other dimensions of the courts intended for each class. An analogous plan of arrangement, showing the manner in which the portions of the Exhibition building allotted to each foreign country will be subdivided, is to be transmitted to the Imperial Commission before the 31st of October, 1865. Plans in detail, on a scale of two centimetres to the metre (1in. to 4·16ft., or 1-50th), showing the place allotted to each exhibitor and to each separate stall, are also to be forwarded with the list of exhibitors by each foreign commissioner before the 31st of January, 1866, in order that in arranging the interior of the Exhibition building the Imperial Commission may be able to take into consideration the wants of each country.

Art. 8.—Each foreign country may claim, for the formation of a special park, the portion of the Champ de Mars adjoining the space allotted to it in the Exhibition building. The representative of each foreign commission will settle with the General Commissioner the plan of the paths for the circulation of the public, and of the earthworks, which will be executed at the cost and under the direction of the Imperial Commission. Each representative will also arrange with the General Commissioner, so as to leave at the disposal of the Imperial Commission the portions of the ground which may be in excess of the wants of his countrymen, or to obtain an additional piece of ground from the portions to which other representatives may have given up their claim. In order to facilitate as much as possible the arrangements of the foreign exhibitors in the portions of the park allotted to them, the Imperial Commission will place at the disposal of the representatives for their guidance the plans adopted by the French exhibitors for arranging the animals, plants, model cottages, &c.

Art. 9.—An official catalogue of the products of all the foreign countries will be drawn up, showing the place which they occupy either in the Exhibition building or in the park. This catalogue will contain two alphabetical lists—one of the exhibitors, the other of the products exhibited. Foreign commissioners are requested to send the information necessary for the preparation of the catalogue before the 31st of January, 1866.

Art.—10.—Those States which can only be represented in Paris in 1867 by a small number of exhibitors, and which are besides in a similar geographical position, are requested to concert together so as to insure a methodical grouping of the products of an analogous nature. The Imperial Commission will place at the disposal of the representatives of the commissions of those States the plans which have been prepared, with a view to harmonize the advantages of such a grouping with the fundamental rule of national representation. In the event of these plans being approved, the Imperial Commission requests the commissioners of these same States to appoint in Paris for each group an agent whose duty it will be to carry them out. The architects and officers of the Imperial Commission will afford assistance gratuitously to these agents.

Art. 11.—In each section assigned to the exhibitors of the same country the objects will be divided into 10 groups and 95 classes, viz.:—

1st Group.—Works of art (classes 1 to 5).

2nd Group.—Apparatus and applications of the liberal arts (classes 6 to 13).

3rd Group.—Furniture and other articles intended for dwelling houses (classes 14 to 26).

4th Group.—Clothing (including fabrics) and other articles worn on the person (classes 27 to 39).

5th Group.—Products (raw and manufactured) of mining (classes 40 to 46).

6th Group.—Instruments and processes of the common arts (classes 47 to 66).

7th Group.—Food (fresh and preserved) in various states of preparation (classes 67 to 73).

8th Group.—Live products and examples of agricultural establishments (classes 74 to 82).

9th Group.—Live products and examples of horticultural establishments (classes 84 to 88).

10th Group.—Objects exhibited with the special purpose of improving the physical and moral condition of the people (classes 89 to 95).

The objects which are included in these groups are given in detail in the System of Classification (Appendix A) annexed to these regulations. In order to avail itself of any suggestions that may be made by the French exhibitors and the Foreign commissioners, the Imperial Commission reserves to itself the right to resolve, in the successive editions of this document, all doubtful questions to which this first publication may give rise.

Art. 12.—No work of art or object exhibited in the Exhibition building or in the Park may be drawn, copied, or reproduced in any manner whatever, without the authority of the exhibitor who is the author of it. The Imperial Commission reserves to itself the right to authorize the taking of general views of the Exhibition.

Art. 13.—No work of art or object exhibited may be removed before the close of the Exhibition without the special authority of the Imperial Commission.

Art. 14.—Neither French nor foreign exhibitors will have to pay any rent for the space occupied by them in the Exhibition, but all costs incurred for fittings and decoration in the Exhibition building and in the park must be borne by them.

Art. 15.—Frenchmen and foreigners, by the act of becoming exhibitors, thereby bind themselves to adhere to these regulations.

Art. 18.—Works by French and foreign artists, executed since the 1st of January, 1855, will be received for exhibition.

Art. 19.—The following will not be received:—1. Copies, including those which reproduce a work in a manner different to that of the original. 2. Oil paintings, miniatures, water-colour paintings, pastels, designs and cartoons for stained glass and frescoes, without frames. 3. Sculpture in unbaked clay.

Art. 22.—The number and nature of the rewards that may be given in respect of works of art, as well as the constitution of the international jury who will be called upon to act as judges, will be decided hereafter.

Art. 23.—All the products of agriculture and industry will be admitted into the Exhibition with the exceptions and limitations mentioned in the following article.

Art. 24.—Detonating, explosive, and other substances of a dangerous nature will not be admitted. Spirits and alcohols, oils and essences, corrosive substances, and generally substances which may affect injuriously other products exhibited, or incommode the public, will only be received in strong vessels, specially adapted for the purpose, and of small dimensions. Percussion caps, fireworks, lucifer matches, and other similar articles can only be received when made in imitation and deprived of all inflammable ingredients.

Art. 25.—Exhibitors of products of an unwholesome and disagreeable nature will be bound to conform at all times to such measures of safety as may be prescribed to them. The Imperial Commission reserves to itself the right to cause the removal of any products, whether French or foreign, which by their nature or their bulk might appear injurious, unsuitable, or incompatible with the objects of the Exhibition.

Art. 36.—Exhibitors of apparatus requiring the use of water, gas, or steam, are to state, when sending in their application for space, what amount of water, gas, or steam, will be necessary. Those who wish to exhibit machines in motion are to state at what speed each of these machines is to be driven and the motive power which it will require.

Art. 39.—The cost of packing and carriage of the goods sent to the Exhibition, and of the goods which have been exhibited there, is to be borne by the exhibitors, both to and fro.

Art. 42.—Packages from foreign countries must be marked in such a way as to show distinctly whence they come. The Imperial Commission will make arangements with the Foreign Commissioners in order that these packages may be transmitted in accordance with the regulations specified in Article 40 for French packages; on this point, however, the Foreign Commissioners will adopt the course which they may consider most advisable.

Art. 43.—French and foreign goods will be received into the Exhibition from the 15th of January, 1867, up to the 10th of March following, inclusive.

Art. 44.—The Exhibition is constituted a bonded warehouse. Foreign goods intended for the Exhibition will be admitted into France, under bond, up to the 5th of March, 1867, by the following ports and frontier towns:—Dunkirk, Lille, Valenciennes, Feignies, Jeumont, Vireux, Givet, Longwy, Thionville, Forbach, Wissembourg, Strasbourg, St. Louis, Pontarlier, Bellegarde, St. Michel, Nice, Marseilles, Cette, Le Perthus, Hendaye, Bayonne, Bordeaux, Nantes, St. Nazaire, Granville, Havre, Dieppe, Rouen, Boulogne, Calais.

Art. 45.—The Imperial Commission will issue special instructions relative to the period when the materials for the buildings, as objects for exhibition, the separate parts of machines and apparatus, heavy and cumbersome articles, and those which require masonry or special foundations, are to be brought into the precincts of the Exhibition. Such works are to be performed by the exhibitors, and at their own cost, in accordance with the plans submitted by them for the approval of the Imperial Commission.

Art. 46.—The Imperial Commission will supply gratuitously the water, gas, steam, and motive power for the machines admitted under the regulation contained in Article 36. This motive power will, except in special cases, be transmitted by a horizontal main shaft, the diameter and the number of revolutions per minute of which will be made known by the Imperial Commission before the 31st of December, 1865. The exhibitors will have to furnish driving pulleys on the main shaft, connecting pulleys, and intermediate shafting for the purpose of regulating the proper speed of the apparatus, as well as the belts necessary for each of these motions. Steam-engines which require to be supplied with steam from their own boilers cannot be shown in the Exhibition building, and special directions will therefore be issued respecting them.

Art. 47.—All other expenses, such as the employment of workmen in the building, the reception and opening of packages, the removal and charge of packing-cases, the construction of counters, stages, glass and other cases, &c., the placing of goods in the Exhibition building and in the park, the decoration of the stalls, and the return of the goods, are to be borne by the exhibitors, French as well as foreign.

Art. 49.—The various stalls and fittings may be erected in the Exhibition as fast as the buildings are completed; they must be commenced at latest on the 1st December, 1866, and must be ready for the reception of goods before the 15th of January, 1867.

Art. 50.—The passages reserved outside the exhibiting space being strictly calculated for the purpose of circulation, packages and empty cases are not allowed to remain therein. Cases must therefore be unpacked as fast as they are received. The Imperial Commission will direct its own officers to unpack for the exhibitors, and at their risk and peril the cases left in the passages intended for circulation. From the 11th to the 28th of March, 1867, the goods already unpacked and placed in the stalls are to be arranged and displayed for exhibiton. The 29th and 30th of March are reserved for the purpose of a general cleaning. A review of the whole Exhibition will take place on the 31st of March. The Imperial Commission will take all measures necessary to have the Exhibition complete in all its parts by the 28th of March. It will, therefore dispose of all those portions of space which on the 14th of January, 1867, are not occupied by stalls ready for the reception of goods, and of all those stalls which on the 10th of March do not contain goods enough to fill them.

Art. 51.—Immediately after they have been unpacked the cases that have been used for the carriage of the goods, either in France or from abroad, are to be removed by the exhibitors or their agents. If they should fail to do this without delay, the Imperial Commission will remove the cases and packing, and will not be in any way responsible for their preservation.

Art. 52.—Special instructions will be published hereafter for the organisation and arrangement of the products and objects for exhibition which are to be placed in the park.

Art. 53.—The name of the producer will be affixed to the goods exhibited. The name of the retailer who usually acts as his agent may be added with the producer's consent. The Imperial Commission will, when required, make arrangements for the exhibition of goods under the name of the retailer when they are not sent for exhibition by the producer.

Art. 54.—Exhibitors are requested to insert after their own names, or the names of their firms, the names of those persons who have contributed in a special manner to the merit of the products exhibited, either as inventors or designers, or by some process of manufacture, or by some remarkable skill in the workmanship.

Art. 55.—The cash price of the objects exhibited and the place where they may be purchased may be stated. This information must be given upon all objects included in Class 91. In all the classes the prices, if stated, must be adhered to by the exhibitor as respects the buyer, under penalty of exclusion from competition. Objects sold may not be removed before the close of the Exhibition without the special permission of the Imperial Commission.

Art. 56.—The Imperial Commission will take every means to preserve from damage the articles exhibited, but it will not hold itself in any way responsible for any loss by fire, or for any accident, damage, or injury, great or small, which may happen to them, from whatever cause it may arise. Exhibitors must take upon themselves the expense of insurance if they should see fit to avail themselves of that precaution. The goods exhibited will be watched by the necessary staff, but the Commission will not be responsible for any thefts or embezzlements which may be committed.

Art. 57.—A special notice posted in the Exhibition building and in the park will make known the staff appointed to organise the interior of the building. It will also contain the names of the officers whose duty it will be to give assistance to the exhibitors, and to watch over the security of the Exhibition.

Art. 58.—A ticket will be delivered to each exhibitor, which will give him free admission to the Exhibition. This ticket will not be transferable. If it should be proved that the exhibitor has lent or given his ticket to some other person, it will be forfeited without prejudice to further proceedings at law. To secure the carrying out of this regulation, the ticket of admission must be signed by the holder, who will have to enter the Exhibition by certain prescribed doors only, and he may be required to establish his identity by signing his name in a book to be kept for that purpose.

Art. 59.—Exhibitors will be allowed to have their goods taken care of by the agents they may select, but they must be approved by the Imperial Commission. Personal tickets of free admission will be given to those agents under the conditions laid down in the foregoing Article. An exhibitor's agent can only receive one ticket of admission whatever number of exhibitors he may represent.

Art. 60.—Exhibitors or their agents must not solicit visitors to make purchases; they will confine themselves to answering inquiries, to handing the address cards, prospectuses, and lists of prices which they may be asked for.

Art. 61.—The Imperial Commission will fix hereafter the prices of admission to be paid by visitors in order to be admitted into the Exhibition.

Art. 62.—An International Jury for making the awards will be formed, divided into nine groups, corresponding with the nine groups of the products of agriculture and industry enumerated in the system of classification. (Art. 11.) The number, the nature, and the various grades of the awards, as well as the constitution and functions of the jury whose duty it will be to apportion them, will be published hereafter.

Art. 63.—The objects will be studied and experiments conducted under the direction of the members of the jury, and of a scientific, agricultural, and industrial commission, appointed by the Imperial Commission.

Art. 65.—Immediately after the close of the Exhibition the exhibitors must begin to pack and remove their goods and fittings. This operation must be completed before the 30th of November, 1867. After that date, the goods, cases, and fittings which may not have been taken away by the exhibitors or their agents will be removed and deposited in a public warehouse at the cost and risk of the exhibitors. The objects which by the 30th of June, 1868, may not have been removed from that warehouse will be publicly sold, and the net proceeds of the sale will be applied to some work of charity.

The following is the form of application for space:—

Committee of Council on Education.—Science and Art Department, South Kensington Museum.—No. 4.—Demand for Space.

Name and Christian Name of Applicant,
or Name of Firm.............................
Nature of Business carried on..................
Address—
No., street, or square ....
Name of town ....
Nature of goods to be exhibited..............
Space the applicant is prepared to occupy—
Length ... feet. Breadth ... feet. Height ... feet.
Remarks—

It is requested that this return, when filled up, may be forwarded not later than the 28th February, 1866, addressed to "The Secretary," South Kensington Museum. "Paris Exhibition, 1867," in the corner.

Fine Arts.

Bordeaux Society of Fine Arts.—The Société des Amis des Arts of Bourdeaux has just published the report of its fourteenth exhibition. The number of works exhibited amounted to 547, of which all but forty were sold. 163 of those sold realised more than £3,000. The exhibition was so well attended that the time of its duration was extended nearly two months. Of the purchases, two paintings and four bronzes were acquired for the museum of the town. The society bought fifty-three works for a sum total of nearly £900; these were distributed amongst its members by lot. The rest of the purchases were made by private persons. The total sums expended for works of art at the fourteen exhibitions of the society amount to nearly £25,000. The receipts of the society exhibit a regular annual increase; the number of subscriptions amounted this year to more than £900, and the whole expenses, including the carriage of the works exhibited, to no more than £360. The Emperor, the General Council of the Department, and the Municipal Council contribute to the exhibition.

Two Pictures by Rubens.—Two important works of this great master, which have been lost sight of for some time, are now in the hands of an amateur in Paris. One represents St. Veronica, the other the regency of Marie de Medicis. The former was executed in Italy, and the Venetians and the Romans both claim the inspiration, as regards style, for their schools; of this picture M. Auguste Conder, of the French Institute, says:—"I have never seen a picture which expresses poignant grief more eloquently. What poetry, what colour, what effect of light, what marvellous gradations of tints! The head of Christ has such an expression of suppressed sorrow and resignation that one cannot avoid being profoundly affected by it." The other picture was executed for the Gallery of the Luxembourg, and its abstraction is not accounted for. Marie de Medicis has one foot in a boat, which represents France; her left hand holds an oar, while her right is in that of Minerva; the goddess tramples under foot old Silenus, who here represents the passions of the multitude. On the right of Minerva is Mercury, with one knee on Silenus, and the right arm supports a horn of abundance, and his left the crown and sceptre of France. Zephyr seizes a butterfly, symbol of pleasure and thoughtlessness. Above is Cupid, who holds a laurel crown in one hand and a palm branch in the other. The drawing and colouring of the picture resemble those of Titian, with the exception of the figure of Silenus, which recals the style of Giorgione. The Venetian critic has said of this picture:—"The allegory of Marie de Medicis, in four principal figures, is of such remarkable beauty, that the composition may be called a poem in painting, to such an extent has the great Rubens shown himself a painter-poet in this picture." The discovery of two such works is an important event.

Commerce.

Cotton and Wine in Algeria.—A report by Consul-General Churchill says that in 1863, 7,455 acres of land were sown with cotton in Algeria, and the produce was 3,548,360 lbs., of which upwards of three millions were produced in the province of Oran, which appears to be better suited for this particular cultivation than Algiers or Constantine. The French government is making great efforts to increase its growth, and is granting a premium on the exportation of native cotton, calculated to allow the cultivator a reasonable profit. Without such a premium, even with the actual high prices, cotton could not be grown cheap enough. The expense attending the cultivation of cotton in Algeria is on an average £16 per acre for the first year, when the soil has to be prepared for this particular kind of cultivation, and £9 12s. per acre the following years. In 1863 eleven twelfths of the cotton produced in the province of Algiers was Georgian long thread, and the remainder Louisiana short thread. But it appears that there is an objection to Algerian cotton, arising from its being generally badly sorted and cleaned, and the fibre is, moreover, knotty and deficient in strength. The cause of this last defect is supposed to proceed from the fact of the produce being ginned before sufficient time has been given it to ripen. The best qualities of the crop of 1863 were sold at Algiers at the rate of £5 16s. the cwt. of unginned cotton. In 1861, 13,745 acres of land were cultivated with the vine, and produced 3,835 tuns of wine. In 1862, 16,062 acres were under cultivation, yielding 4,529 tuns of wine, besides 20 millions of pounds of grapes. The wine produced is as yet, however, of an inferior quality. Its flavour is not unlike that of the sweet wines of Spain and Portugal, and it is very heady.

Maize Sugar.—Monsieur B. Dureau, the editor of the *Journal des Fabricants de Sucre*, gives the following account of the attempts that have been made in France to extract sugar from maize:—"At the time of the continental blockade, when we were at war with England, and when France and a considerable portion of Europe besides was deprived of colonial produce, attempts were made to undertake on a grand scale the manufacture of grape sugar, and experiments were made with different plants in order to obtain sugar: the maize was one of these, and Parmentier pursued his researches in order to extract sugar from it: this, however, he only succeeded in doing in the form of non-crystallisable syrup. These researches are set forth in his work on the 'Manufacture of Syrups,' which bears the date of 1813. Ten years later, Marabelli, of Pavia, extracted sugar from the maize; then came Burget, Deyeux, Pictet (1811), Dr. Neuhold, Pallas (1824), Biot, and Sobeiran. But no part of these experiments, so far as I have read, established the fact that a really crystallisable sugar could be made from maize; syrup only was extracted. In 1842, some experiments were made in Louisiana, which clearly proved that the sugar corn contained a large portion of crystallisable sugar, but I am not aware that they succeeded in practically obtaining any quantity. The extraction of sugar seems to present great difficulties. Nevertheless, M. Neuhold succeeded in extracting about 70 or 71 litres of juice from 1,000 maize stems; and from this he has extracted 12 lbs. of good syrup, and this again furnished him with 3½ lbs. of crystallised sugar, and 8½ lbs. of molasses. Whether this product deserved the name of crystallisable sugar, and whether it could stand a comparison with that which we get from the cane, I do not know. M. Lapanouse has repeated Neuhold's experiments, and from 100 lbs. of canes extracted about 9 or 10 lbs. of good syrup. M. Pallas could only get 360 grammes of syrup from 7 kilogrammes of maize cane—about a fourteenth part. That maize contains a considerable amount of sugar is evident, but at what particular period in the growth of the plant the sugar is crystallisable, and what quantity can be practically extracted from it, is the important point not yet resolved."

Tea in Ceylon.—It appears that the cultivation of tea has been tried to some slight extent in Ceylon, and there seems to be no doubt that it can grow tea as well as Southern India or Assam. It is possible that in the course of a few years a fresh source of supply may be added to the numerous places of production which of late have contributed to swell our imports. At present the planters of Ceylon appear almost dependent on the cultivation of coffee.

Zante Petroleum.—A company has been formed for developing a valuable petroleum property in Zante, one of the Ionian islands. There are two valuable springs of it, which, there is good reason to believe, have yielded this product for more than 2,000 years. The historian Herodotus referred to these oil springs in the following terms:—"I myself have seen pitch drawn up out of the water from a lake in Zacynthus (Zante). At the place I speak of there are a number of lakes, but one is larger than the rest, being 70 feet every way, and two fathoms in depth. Here they let down a pole into the water, with a bundle of myrtle tied to one end, and when they raise it again there is pitch sticking to the myrtle, which in smell is like to bitumen, but in all else is better than the pitch of Pieria. (Note by Rawlinson—"The pitch of Pieria was considered the best in Greece.") This they pour into a trench dug by the lake's side, and when a good deal has been got together, they draw it off and put it up in jars." (Rawlinson's Translation, Book 4, Chapter 195.) Rawlinson adds "Zante still produces large quantities of mineral pitch." Dr. Chandler, writing before petroleum was known as an article of commerce, thus describes the "tar springs," as he calls them, of Zante:—"The tar is produced in a small valley about two hours from the town, by the sea, and encompassed with mountains, except towards the bay. The spring which is most distant and apt for inspection rises on the further side, near the foot of the hill. The well is circular and four or five feet in diameter. A shining film-like oil mixed with scum swims on the top; you remove this with a bough and see the tar at the bottom, three or four feet below the surface. * * * * We filled some vessels with tar, by letting it trickle into them from the boughs which we immersed, and this is the method used to gather it into pits, where it is hardened by the sun, to be barrelled when the quantity is sufficient. (Chandler's Travels, vol. 2.) The demand in Europe for petroleum, both for lubricating and lighting purposes, is rapidly increasing, as appears from the following quantities imported into Europe from the United States during the last four years, viz.:—1,194,682 gallons in 1861; 10,887,701 in 1862; 28,161,191 in 1863; 31,787,951 in 1864. Dr. Paul, in his report, states that as much as five barrels a day may be collected from these wells, and Dr. John Davy, who visited the wells in 1824, states that one hundred barrels had been collected in one year. These estimates may both be far from the actual yield, since the material has hitherto been collected only at times when it happened to be wanted; but, without special arrangements for gauging the daily flow of petroleum from the wells, and without precise observations, extending over some time, it would be impossible to form a more accurate estimate as to the quantity of the spontaneous exudation. It is important, however, to remember that this exudation is to be regarded only as the index of a subterranean store of petroleum, and that it is certainly much more considerable than has been observed in the case of other abundant sources of petroleum, such as those of America, for instance, where the indications of the existence of petroleum consisted merely in the greasy character of the water from springs, or the presence of a film of oil on the surface of stagnant water in the neighbourhood. Another circumstance connected with this exudation in Zante appears to be highly significant of the existence of a considerable subterranean source of supply. This is the very great length of time during which the large spontaneous flow above referred to has continued without any artificial aid. Thus the description of the wells, given by Herodotus more than 2,000 years ago, from his observation of them, is almost equally applicable at the present time.

Colonies.

Agriculture in Victoria.—The Legislative Council has published a return that throws some light on the disputed point as to whether the agricultural or the pastoral produce was of the greater value to the colony of Victoria. The returns show that the number of acres occupied by farmers in 1864 was 2,697,981, and by squatters, 31,683,306. The value of the agricultural produce raised in that year was £3,676,250, and of the produce raised by the squatters, £3,316,793. Thus the farmers raised a greater amount of produce than the squatters, and from less than a tenth part of the land, the year having also been a most unfavourable one for the farmers, as owing to a failure of the crops the yield of wheat was less than half of an average. The total number of persons engaged in agricultural pursuits, both male and female, was 41,218, and in pastoral pursuits, 9,724. The value of machinery used by the farmers, including one steam-plough and one steam-engine used for irrigation, reaping and threshing-machines, &c., was calculated to be about £129,960, whilst the number of men in attendance on these machines was almost equal to the number employed by the squatters for all purposes. To the above amount of £3,676,250 should be added £1,136,716, the declared value of flour, wheat, &c., imported, to show the quantities required for the annual consumption of the colony.

Kerosene in New South Wales.—The discovery in this colony of mineral shale, producing kerosene oil, is more extensive than is generally supposed. A kerosine and paraffine oil company has already been established, and numerous truck-loads of their raw material are forwarded by rail to Sydney. The district of the Hartley appears to be very rich in this mineral. The examinations and experiments that have been made are said to justify very sanguine expectations. The extensive use of this shale in the manufacture of gas will improve its quality.

Timber Trade in West Australia.—This trade is progressing favourably; all the stations are fully engaged in cutting timber, large orders having been received for exportation to South Australia, Calcutta, and Bombay. There appears to be ample encouragement for a great extension of cutting operations, and it is expected that the timber trade of this colony will greatly increase.

British Property in Victoria.—The Custom-house returns show that four-fifths of the ships annually frequenting Port Philip are the property of British owners, and that of their total estimated value, £4,770,000, £4,000,000 represents the interest that British merchants have in them. The cargoes brought by these ships from the United Kingdom and from British possessions are valued at £10,000,000, and the colonial produce they take away, consisting chiefly of gold and wool, is worth £9,750,000. Both the ships and cargoes are for the most part insured in British offices. The property of the banking and other financial institutions in Victoria is estimated at £10,000,000, and £8,000,000 of this amount may be said to represent British capital, whilst the stocks of British merchandise stored in the Melbourne warehouses are seldom of less value than £5,000,000—about sufficient for six months' consumption. It is feared that the clip of wool will be unusually light this season, the sheep having suffered much from scarcity of food; and the result of the lambing season is not satisfactory.

Publications Issued.

A Richard Cobden. (Paris; folio.)—This volume is a splendid testimonial to the memory of Richard Cobden, furnished by several of his most intimate friends in France. The introduction is by M. Emile de Girardin, who sketches the services of Mr. Cobden during the last quarter of a century. M. Michel Chevalier contributes a long and minute biography of his late friend; and M. Castagnary has collected and arranged the expressions of sympathy which issued on the receipt of the sad news of Cobden's death from the press, the tribune, and the official world, including an autograph letter from the Emperor and one from Prince Napoleon. The volume is illustrated by a fine portrait of Mr. Cobden, and a figurative frontispiece. The Imperial letters, the biography by M. Michel Chevalier, and a long letter addressed to the latter by Mr. Cobden, are all printed in *fac-simile*, and the whole is executed with the greatest care, and printed on the finest paper. It is a memorial which the family of Richard Cobden must regard with deep though melancholy satisfaction. It is not often that one country pays such a tribute to the memory of the son of another.

Le Parthenon. By M. Marchal. (Paris.)—M. Marchal, the author of an interesting book of travels in Senegal and China, has published at once a reproach and an appeal to the nations of Europe in favour of the artistic remains of ancient Greece. He complains not only that we despoil the classic land of the finest remains of her former glory, but that we do not aid her in preserving, and, as far as possible, reconstructing the temple raised by Pericles to "Human wisdom, personified in Minerva." It appears that some persons have conceived the idea of converting the Parthenon into a dancing hall, and against such profanation M. Marchal protests energetically, and in this protest assuredly all lovers of art and all elevated minds will cordially join; but if the government of Greece cannot protect the monuments of her own glory, there is not much probability of other nations doing for her what she does not exhibit an inclination to do for herself. On the other hand, the manifestation of a desire to preserve the Parthenon and other ruins would doubtless soon induce others to aid in the work.

Guide Theorique et Pratique de l'Amateur de Tableaux. By T. Lejeune. (Paris. 8vo.)—The appearance of the first and second volumes of this work was noticed in the *Journal* of the 9th of December last. The third and concluding volume has recently been issued. It contains an alphabetical list of the painters of all schools, from the earliest period to the present time, about nine thousand in all, with the place and dates of birth and death, sales with prices of important pictures, and other information not included in the body of the work. The remainder of the volume is occupied by an alphabetical list of signatures, monograms, and marks of artists, executed in *fac-simile*, probably the most complete yet published. M. Lejeune had peculiar advantages in the construction of this table; he is one of a family of artists and collectors well known in the arts for a century, and the present list is the result of the labour of his predecessors, enlarged and corrected by himself during his long experience as restorer of pictures in the Imperial galleries of France, and as conservator of several very important galleries, including those of Duchâtel, Fould, de Morny, and Soult, and from his researches abroad. As an instance of the corrections may be mentioned that of the name of a well-known artist, which has usually been written Memling, but which M. Lejeune clearly shows to have been Hemling, the error having arisen from a peculiar form adopted by that painter for the initial letter of his name. The careful execution of the blocks of these monograms and signatures gives great value to the work.

Notes.

Paris Exhibition of Insects.—This curious exhibition has attracted the attention of men of science and agriculturists, but most particularly of those who are interested in the rearing of bees and silk worms, which naturally occupy the chief places. The collection of bee-hives, some shown in operation, and of other matters connected with the rearing and management of these interesting insects, is considerable, and presents forms, in some instances, strange to English eyes. In addition to the bees themselves and the material referred to, are specimens of their products and of the articles into which they enter, such as honey, wax, mead or hydromel, sweetmeats, and confectionary. The largest portion of the exhibition, however, was occupied by matters connected with the production of silk. An admirably arranged collection was shown by M. Jules Rieu, of Valréas, in the department of Vaucluse, including the white and yellow cocoons of the Japanese silk worms, introduced into France in 1863, and extensively bred by M. Rieu; green cocoons also from Japan, introduced in the present year; silk spun from these various cocoons; models of the frames and other material used in the silk cultivation; and specimens of the insects themselves in the various stages of their existence. M. Guerin-Meneville, M. H. Givelet, and others, exhibited numbers of the *Bombyx cynthia*, and of other worms produced by the crossing of the former with the *Bombyx arrindia*, feeding on the leaves of the ailanthus, and also several chambers containing cocoons and hundreds of enormous moths depositing their eggs. Others show products, preparations and sketches of the *Bombyx yama mai*, a very large green worm that feeds on the oak, and of many other new and curious species. But the ailanthus worm seems to have attracted the greatest attention, and its cultivation, as already stated in the *Journal*, is rapidly extending. M. Givelet, who published a report on the subject not long since, read a paper at the exhibition some time since, and promises a more complete account of the best method of bringing this worm into cultivation on a large scale during the coming winter. This gentleman commenced planting the ailanthus at the Chateau of Flamboin in 1860, and, after some misfortunes and disappointments, completely succeeded in the breeding and rearing of the worms. He reports that during the present season he has collected about twenty thousand cocoons, and that about three times that number are now on the trees in his plantation. The museum of Natural History, at the *Jardin des Plantes*, contributed a fine collection of insects, with specimens of timber and other substances which have suffered from their ravages; also some remarkably large specimens of lobsters, and crayfish from American waters. Another remarkable collection of insects is from Mr. T. Glover, the entomologist attached to the Department of

Agriculture at Washington. M. E. Mocquerys, of Evreux, has an admirable exhibition of coleopterous and other insects which feed on the vine, cereals, and other industrial plants. Dr. Eugène Robert contributed a series of sections of trees ravaged by xylophargous insects, together with illustrations of the methods which have been adopted by the authorities of Paris and other places, under his superintendence, for their destruction. There were other collections of more or less importance, and, amongst the curiosities of the exhibition, a landscape produced entirely by the arrangement of various coloured beetles. Apparatus and powders for getting rid of certain classes of noxious insects were numerous in the exhibition, amongst which, judging from the number of medals and awards granted to the discoverer, the powder produced from the flowers of the *Pyrethrum Willemoti* seems to hold the highest place. It appears that the flowers of various plants of this family are extensively used in Persia, Armenia, and other countries, for like purposes. The Persian powder is said to be composed chiefly of the flowers of the *Pyrethrum carneum*, while the Armenians prefer the *Pyrethrum roseum*.

Great Aqueduct.—The conveyance of the waters of the river Dhuis to Paris ranks amongst the most important public works of its class, and, being just completed, a short account of the undertaking will not be uninteresting. The object is the increase in the supply of the amount of water for the consumption of Paris, and especially that of the higher levels of the city. The aqueduct of the Dhuis, or Dhuys, commences at Pargny, in the Aisne, and traverses the departments of the Seine-et-Marne, Seine-et-Oise, and Seine, its total length being about 135 kilomètres, or upwards of eighty English miles; the whole is constructed in solid masonry, with a fall of about seven inches in the mile, with the exception of about nine or ten miles, where the waters are carried through valleys by means of cast-iron syphon pipes, fifty-five inches in diameter, and having an average inclination of rather more than thirteen inches to the mile. The stone aqueduct lies underground throughout about six miles of its course, four of the principal tunnels being from eight hundred to upwards of two thousand yards in length. Four of the syphons are from a thousand to nearly five thousand yards long. The aqueduct was commenced in June, 1863, and completed last month, and the total cost, including indemnities to the proprietors of land, is said to have amounted to between £600,000 and £700,000. In the afternoon of the eleventh of the present month, the waters of the Dhuis arrived at the entrance to the great reservoirs of Menilmontant, described in the *Journal* of March 10th and April 21st; and in a few days, when the aqueduct and syphons are completely cleansed by allowing the water to pass directly through them into the sewers, the reservoirs will be filled and the service commenced. The Dhuis aqueduct is calculated to furnish about 40,000 cubic mètres of water in twenty-four hours, and that of the Marne with other supplies now brought to Paris, about four times that quantity, or 200,000 cubic mètres in all per day. Some idea of the magnitude of these works may be formed from the fact that the stopcocks or valves which close the main supply-pipes at their junction with the reservoir weigh more than four tons each. The pipes themselves are more than thirty-nine inches in diameter, and the valve or stopcock consists of a disc of cast-iron, which is set in the direction of the length of the pipe, or transversely, according as the water is to be turned on or off.

Patents.

From Commissioners of Patents Journal, September 22nd.

Grants of Provisional Protection.

Agricultural implements, propelling—1618—V. Poitevin.
Blacksmiths' bellows—2152—J. Bowden.
Bobbins of machines, fixing the, on to their spindles—2250—J. Ward
Boiler and tea kettle bottoms—2237—M. Judge.
Boots, &c., elastic material for—2132—M. Cartwright and A. Dale.
Bottles, stopping—2246—W. T. Read.
Carriages, disengaging runaway horses from—2214—R. T. Holmes.
Copying presses—2186—G. Owen.
Cotton seeds, preparing, for crushing—2196—F. A. E. G. de Massas.
Crinolines, imitation embroidery for—2131—R. Clarke.
Fabrics and threads, washing—2126—R. A. Brooman.
Fire-arms and blasting, charges for—2266—C. Reichen.
Fire, &c., warning of—2064—C. West.
Fringes and trimmings, ornamentation of—2280—T. B. Bailey.
Hair brushing machinery—2278—J. Neat and F. Ford.
Horses, &c., shearing or clipping—2172—J. G. Tongue.
Ice safes—2244—H. C. Ash.
Iron—2018—E. Sabel.
Iron bridges, &c., constructing—2226—W. Brookes.
Light, production of—2184—E. A. Curley.
Paper pulp—2248—W. E. Newton.
Peat, treating—2219—H. Terrell and T. Don.
Railway carriages, brakes for—1431—J. X. J. Barbaix.
Railway carriages, couplings for—2082—R. D. Morgan.
Railway carriages, &c., coupling for—2268—S. R. Freeman and A. Grundy.
Railway trains, stopping or retarding—2154—W. Shakespear.
Rivets—1531—C. de Bergue.
Safes and strong rooms, metallic—2265—S. Chatwood.
Screws—2240—W. Carron.
Sewing machines, self-acting—2218—G. Zanni.
Shafts, lubricating—2288—W. Mycock.
Ships' bottoms, coating—2120—S. Parry.
Ships' fastenings, iron—2010—P. Cato.
Soap—2140—A. Watt.
Steam boilers, fixing and unfixing the tubes of—2284—S. Soutar.
Submarine telegraph cables—2088—H. R. Guy.
Submerged telegraph cables, recovering—2134—J. L. Clark.
Sulphide of iron from coal, separation of—2252—T. Lomas.
Tea and coffee pots and urns—1950—T. Brown.
Two-wheeled carriages, springs for—2242—W. George.
Windows, cleaning—2243—G. Smeaton.

Inventions with Complete Specifications Filed.

Feathering paddlewheel—2380—G. A. Keene.
Locomotive car—2344—J. P. Woodbury.
Windows—2349—S. Wales.

Patents Sealed.

563. F. McD. and D. Chalmers.
833. R. Lublinski.
835. J. Green.
863. J. Bruckshaw and W. S. Underhill.
864. F. le Roy.
874. A. D. Gascon.
876. F. A. Mocquard.
883. W. N. Wilson.
884. W. Irlam.
885. W. Brookes.
904. T. Cook.
964. J. Bethell.
1039. H. Bridson.
1040. C. Boschan, J. Bindtner, and W. Caffou.
1084. T. Whitehead & N. Nussey.
1445. W. Clark.
1641. G. Haseltine.

From Commissioners of Patents Journal, September 26th.

Patents Sealed.

616. T. Turton.
860. J. Rooke.
870. J. Millar and J. Laing.
871. J. C. C. Halkett.
875. F. Thomas.
877. R. Young and C. F. G. Glassford.
878. F. W. Webb.
880. E. Savage.
881. I. L. Pulvermacher.
886. R. C. Robinson.
887. E. and F. A. Leigh.
888. F. A. Leigh.
896. W. M. Neilson.
898. W. Savory.
899. W. Brookes.
900. A. A. Croll.

Patents on which the Stamp Duty of £50 has been Paid.

2580. H. R. Fanshawe.
2585. C. Mertens.
2613. T. Kennedy.

Patents on which the Stamp Duty of £100 has been paid.

2200. S. Stimpson.
2149. W. Richards.
2161. G. L. Turney.
2156. C. Hall.
2173. T. Britt.

Registered Designs.

Multum in Parvo Shaft Tug—September 14—4742—Charles Watson, 5, King-street, Portman-square.
Pipe Wrench—September 15—4743—W. Maiden, Waterloo, near Ashton-under-Lyne.
Spring Chimney Holder—September 20—4744—Edward Alex. Rippingille, 118, Holborn-hill.